Water Management Plan

United States Environmental Protection Agency
National Health and Environmental Effects Research Laboratory
Mid-Continent Ecology Division
6201 Congdon Boulevard
Duluth, Minnesota 55804

21 January 2004

Point of Contact:
Rodney Booth
Facilities Manager
218-529-5040

EPA

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
NATIONAL HEALTH AND ENVIRONMENTAL RESEARCH LABORATORY
MID-CONTINENT ECOLOGY DIVISION

WATER MANAGEMENT PLAN

Approved by:

Rodney Booth, Facilities Manager — Date 1/21/04

for Janet R. Keough, Acting Division Director — Date 1/22/04

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1.0 EPA'S STATEMENT OF PRINCIPLES ON EFFICIENT WATER USE

In order to meet the needs of existing and future populations and ensure that habitats and ecosystems are protected, the nation's water must be sustainable and renewable. Sound water resource management, which emphasizes careful, efficient use of water, is essential to achieve these objectives.

Efficient water use can have major environmental, public health, and economic benefits by helping to improve water quality, maintain aquatic ecosystems, and protect drinking water resources. As we face increasing risks to ecosystems and their biological integrity, the inextricable link between water quality and water quantity becomes more important. Water efficiency is one way of addressing water quality and quantity goals. The efficient use of water can also prevent pollution by reducing wastewater flows, recycling process water, reclaiming wastewater, and using less energy.

EPA recognizes that regional, state, and local differences exist regarding water quality, quantity, and use. Differences in climate, geography, and local requirements influence the water efficiency programs applicable to specific facilities. Therefore, EPA is establishing facility specific Water Management Plans to promote the efficient use of water and meet the water conservation requirements under Executive Order 13123, Greening the Government Through Efficient Energy Management.

This Water Management Plan has been established to document and promote the efficient use of water at the U.S. EPA Mid-Continent Ecology Division Laboratory facility located in Duluth, Minnesota. The plan is organized according to the Federal Energy Management Program (FEMP) Facility Water Management Planning Guidelines under Executive Order 13123.

2.0 FACILITY DESCRIPTION

The U.S. EPA Mid-Continent Ecology Division Laboratory (MED) facility located in Duluth, Minnesota houses five of the Division’s six branch activities:

- Ecosystem Assessment Research;
- Ecotoxicity Analysis Research;
- Molecular and Cellular Mechanisms Research;
- Toxic Effects Characterization Research; and
- Watershed Diagnostics Research.

The laboratory was originally constructed as the National Water Quality Laboratory in 1967, part of the Department of the Interior, Federal Water Quality Administration. In 1970 the laboratory joined the newly formed U.S. Environmental Protection Agency. The laboratory facilities are located on a 13.2 acre site located near the Lester River on the east side of Duluth on the shore of Lake Superior and are owned and operated by EPA. The site consists of ten buildings with 88,577 gross square feet of conditioned space.

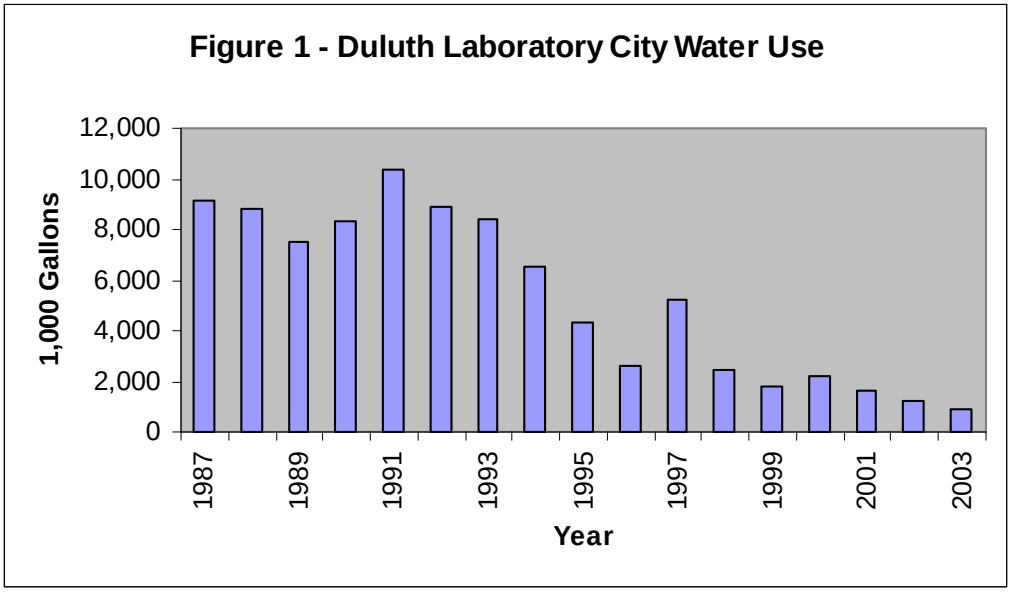
The main laboratory building was finished in 1967, with additions constructed in 1984 and 2001. Construction is of reinforced concrete and masonry curtains; the two-story structure is built around a central mechanical core that extends up to a third floor penthouse. The building houses both biology and chemistry labs and a large aquatic culture unit. Significant features include 50 laboratory rooms, 7 constant temperature rooms, a digital control facility management systems (Metasys) and a lake water supply system. The building also houses the administrative offices and library for the Division.

The Annex building was constructed in 1971 and modified in the late 1980s to provide office and support space for 50 staff. Other support buildings and structures include a shop/storage building, several storage buildings, pump house, water tower, emergency generator building, and a modular hazardous material storage building.

Duluth was selected as the site for this research facility because of the need for an uncontaminated source of natural fresh water (Lake Superior) to conduct its research. The lake's unchanging water quality over the past 30 years has been essential to the ongoing ecotoxicology research performed at MED. The facility uses Lake Superior water for research and non-contact cooling of building air conditioning and other mechanical equipment.

3.0 FACILITY WATER MANAGEMENT GOALS

Since 1993, MED has embarked on a comprehensive program to reduce consumption of potable water. Between fiscal years 1993 and 2003, potable water consumption was reduced by 90 percent, as illustrated in Figure 1.



Continued further definition and achievement of water management goals will be accomplished through the implementation of the MED Environmental Management System (EMS). The EMS

is being established consistent with the EPA Environmental Policy Statement. The Environmental Policy Statement and MED water conservation goals are provided below.

Environmental Policy Statement

EPA's mission is to protect human health and safeguard the natural environment by setting standards for environmental protection, assisting others in reducing or preventing pollution, conducting environmental research and enforcing environmental protection standards in conjunction with other government agencies. In support of that mission, proper management of the environmental impacts of our operations and facilities is essential.

EPA continues to encourage regulated entities to use effective EMSs that focus on compliance, pollution prevention, and public outreach. With this policy, EPA is committing to implement EMSs with these attributes for our own employees, operations and facilities. EPA will endeavor to become a leader in executing a model environmental management system within the Agency.

At EPA, we commit to reduce the environmental impacts and consumption of natural resources from our facility operations and comply with all legal and applicable requirements. Our EMS will be designed to meet the following goals:

- Ensure compliance by meeting or exceeding all applicable environmental requirements;
- Strive to continuously improve environmental performance in terms of both regulated and unregulated environmental impacts (e.g., energy and water conservation);
- Employ source reduction and other pollution prevention approaches whenever practicable;
- Require consideration of environmental factors when making planning, purchasing and operating decisions;
- Establish, track and review specific environmental performance goals; and
- Share information on environmental performance with the public and allow appropriate opportunities for input into EMS development and implementation.

In view of this environmental policy, MED has reviewed its water consumption and wastewater discharges. In addition to the continuous improvement approach to reducing potable water consumption illustrated above, MED has identified the discharge of water from the wet lab to the sanitary sewer as a significant environmental aspect. Two targets have been established related to this aspect:

1. Investigate recirculating culture water or discharging culture water to Lake Superior, thereby reducing discharge to sanitary sewer by 80 percent by December 2006.

2. Reduce usage of culture water by 5 percent.

4.0 UTILITY INFORMATION

Contact Information

Potable water and sewer service is provided by:

City of Duluth
Public Works and Utilities Department
414 West First Street
PO Box 169001
Duluth, Minnesota 55816-9001

(218) 723-3333

Rate Schedule

The water billing rate is $1.73 per 100 cubic feet, for the first 40 units. $1.13 per 100 cubic feet, over 40 units.

The sewer use fee is $3.25 per 100 cubic feet.

The utility also charges as fixed rate between $25 and $49 for each installed water meter.

The storm water fee is $289 per month (calculated as 77.3 residential units at $3.75 per unit).

Payment Office

U.S. EPA - Environmental Research Laboratory
Attn: Account Operations
6201 Congdon Blvd.
Duluth, MN 55804

(218) 529-5000

5.0 FACILITY INFORMATION

The predominant feature of the MED Duluth Laboratory from a water management perspective is its proximity to Lake Superior. Lake water is used as aquatic culture water in the wet lab, research water in various laboratories, and non-contact cooling water used for building air conditioning and to cool other mechanical equipment.

All lake water passes through a primary lake bottom sand filter located 800 feet from shore at a depth of 50 feet. The filter is designed to filter particulate matter down to five microns. Water flows by gravity through the sand filter into a wet well and is then pumped to a 40,000 gallon capacity water tower. As needed, water flows into the main building by gravity through two separate lines: research and cooling water. This system was designed to provide a reliable source of lake water with minimum operating and maintenance costs. During extremely cold weather, water is pumped continuously to the water tower and allowed to overflow via a return line to the lake to prevent the water in the tower from freezing.

Lake water used for research flows through in-house sand filters designed to filter particles down to two microns. The research water then passes through a UV light disinfection system before being supplied to the various laboratories, unchanged in chemical makeup from the raw lake water. This system is capable of producing 100,000 gallons of water per day. Some research activity requires heating or cooling the lake water, which is accomplished by routing the water through stainless steel chillers or heat exchangers. Lake water used for research purposes is discharged to the city sewer system.

Some lake water required for research purposes is further processed through two reverse osmosis (RO) filter units, followed by deionization units. This water is stored in PVC storage tanks and treated with UV light to generate Type II pure water for laboratory water use. Design capacity of this system is approximately 600 gallons per day. Water rejected from the RO unit is returned to the lake.

Lake water used for non-contact cooling receives no additional treatment. After non-contact use, the water is returned to Lake Superior. This system is capable of supplying 300,000 gallons of water per day.

Use of potable water supplied by the city has been reduced significantly since the early 1990s (see Section 3), and is now used primarily for sanitary requirements, janitorial needs, and some other miscellaneous uses. Potable water used for these purposes is discharged to the city sewer. The facility is not equipped with an irrigation system; therefore, virtually no water is used for landscape irrigation.

Major Water Using Processes

Average water use in FY 2003 by major process is shown in Table 1. The source of water for each purpose, either city or lake, is indicated on the table, as well as whether the water is discharged to the city sewer, or returned to the lake.

Table 1

Major Water Using Processes - Duluth Laboratory

Process	Water Source	FY 2003 Annual Consumption (gallons)	Percent of Total	Discharge Method	Comments
Sanitary	City	750,000	0.6	Sewer	Engineering estimate
Miscellaneous lab uses	City	223,000	0.2	Sewer	Calculated as remaining difference from metered subtotal
City water subtotal	City	973,000	0.8	Sewer	Metered
Aquatic culture water (Wet Lab)	Lake	18,846,849	15.6	Sewer	Metered
Research water	Lake	5,930,000	4.9	Sewer	Calculated as remaining difference from metered sewered subtotal
Reverse osmosis permeate	Lake	30,633	<0.1	Sewer	Metered
Sewered water subtotal	City & Lake	25,780,000	21.3	Sewer	Metered
Reverse osmosis reject	Lake	400,640	<0.1	Returned to lake	Calculated from metered flow rates
Non-contact cooling water (building and equipment cooling)	Lake	78,000,000	64.6	Returned to lake	Calculated as remaining difference from metered subtotal
Water tower overflow (to prevent freezing in winter)	Lake	17,000,000	14.1	Returned to lake	Engineering estimate
Lake water subtotal	Lake	119,786,700	99.2		Metered
Total water use	City & Lake	120,759,700	100		Sum of metered subtotals

Additional detail on assumptions and calculations supporting these water use estimates are provided in Appendix A.

Measurement Devices

Incoming city water supply and lake water supply are both metered. Flow totalizing meters are also installed on many of the subsystem flows. An inventory of metered flows (with meter number) is provided below:

- City water supply, main building (#18)
- City water supply, annex (#19)
- Domestic hot water (#7)
- Lake water supply (#1)
- Lake water to research use (#2, #3, #4)
- Wet lab warm water supply (#12)
- Wet lab cold water supply (#13)
- Non-contact water for primary chiller and heat exchanger (#5)
- Non-contact water for chillers 1 and 4 (#6)
- RO system total consumption (2 meters, not numbered)
- RO system permeate (2 meters, not numbered)
- Sewer Flow (#11)

Flow totalizer readings are recorded monthly and reported to the facilities manager. Water use trends are monitored on an ongoing basis and unexpected changes in water use are investigated and resolved.

Shut-off Valves

City water supply line shutoffs are located in the boiler room of the main building (Room 200) and annex building Room A-108. Lake water supply can be shut off at the pump house.

Occupancy and Operating Schedules

Approximately 150 employees work at the Duluth laboratory. The laboratory operates on a flex time schedule and is typically occupied between 6:00 a.m. and 6:00 p.m., Monday through Friday.

6.0 BEST MANAGEMENT PRACTICE SUMMARY AND STATUS

The Federal Energy Management Program (FEMP) has identified water efficiency improvement Best Management Practices (BMPs) in ten possible areas. Implementation of BMPs in four or more areas are required under FEMP guidance. The Duluth Laboratory has adopted and will maintain BMPs in six of the ten areas:

- ✓ Public Information and Education Programs
- ✓ Distribution System Audits, Leak Detection and Repair
- ✓ Water Efficient Landscape
- ☐ Toilets and Urinals
- ✓ Faucets and Showerheads
- ✓ Boiler/Steam Systems
- ✓ Single-Pass Cooling Systems
- ☐ Cooling Tower Systems
- ☐ Miscellaneous High Water-Using Processes
- ☐ Water Reuse and Recycling

Public Information and Education Programs (BMP #1)

The Duluth Laboratory promotes water conservation and awareness using the EPA laboratory "Every Drop Counts." water conservation poster series. Conservation posters are displayed in prominent locations within the building. In addition, the laboratory prepared an educational poster on their native landscaping project for display in the facility lobby for staff and visitors. Employees are being educated on water and other resource conservation topics though the implementation of laboratory EMS. Utility consumption rates, including water use, are routinely provided to laboratory staff, so that they get feedback on how their actions impact resource consumption.

Distribution System Audits, Leak Detection and Repair (BMP #2)

A screening level system audit was conducted in November 2003 and known water uses account for greater than 90 percent of water consumption.

Water supply piping within the facility is exposed and accessible. Facility staff are trained to report leaks and malfunctioning water using equipment to a facility maintenance help line. Reported problems are assigned a work order, which is completed by the facility operation and maintenance (O&M) contractor.

Water Efficient Landscape (BMP #3)

The Duluth Laboratory is located on a 13.2 acre parcel, with four acres developed to include the laboratory buildings, parking, and landscaped areas. No installed irrigation is used to maintain facility landscaping. In 2003, two acres of lawn in front of the laboratory where converted to northern boreal meadow, native to northeastern Minnesota. Some spot watering of these new plants may be required for stressed vegetation during dry periods until the restored meadow is established, which is expected to take two to three years.

Toilets and Urinals

Water-efficient sanitary fixtures (1.6 gallons per flush (gpf) toilets and 1.0 gpf urinals) have been installed in the new administrative wing of the laboratory, the research storage building, and the first floor of the annex building. Older style toilets and urinals (with flow rates estimated to be 5 gpf) installed as part of the original laboratory construction are still in use in the main laboratory area and the second floor of the annex building. In total, 8 of 21 toilets and 3 of 5 urinals are water efficient. Best management practice status can be achieved in this area by upgrading the older style sanitary fixtures to water-efficient designs.

Janitorial staff and employees are trained to report leaks or other maintenance problems, which are immediately corrected by the O&M contractor.

Faucets and Showerheads (BMP #4)

Ultra-efficient lavatory faucets (0.5 gallons per minute (gpm) with automatic sensors to control flow have been installed throughout the laboratory facility to conserve water. A total of 10 of 15 lavatory sinks have been equipped with ultra-efficient faucets. In the remaining cases, lavatory faucets have not been converted to the automatically-controlled, ultra-efficient design so that staff can have ready access to manually operated taps to fill coffee pots and for other general purpose needs. Water-efficient shower heads (2.5 gpm) are installed in all shower stalls (7 total). System pressure is maintained between 20 to 80 pounds per square inch.

Janitorial staff and employees are trained to report leaks or other maintenance problems, which are immediately corrected by the O&M contractor.

Boiler/Steam Systems (BMP #5)

Boilers produce recirculating hot water, rather than steam. No steam condensate is generated. A steam generator used to supply distilled water was removed in 1998 and replaced with the current RO system.

Single Pass Cooling Equipment (BMP #6)

Since the early 1990s the Duluth Laboratory has made a concentrated effort to eliminate all uses of potable water for single pass cooling. This is one of the primary reasons for the reduction in potable water use over the past decade. Non-contact cooling water needs are all supplied by recycled lake water.

Cooling Tower Systems

Cooling water requirements are supplied by lake water; the laboratory is not equipped with a cooling tower.

Miscellaneous High Water-Using Processes

Approximately 35 to 40 gallons per minute of lake water is used for aquatic culture in the wet lab. Water is provided to each culture tank in a constant overflow mode to keep the tanks aerated and carry away waste products. Currently, this water is discharged to the city sewer, rather than returned to the lake, in keeping with the facility's NPDES permit. Direct discharge of this water to the lake is not currently permitted. The laboratory is planning a project to design and install an aquatic culture water treatment and recycling system that would allow it to reuse a significant portion of the aquatic culture water currently discharged to sewer. BMP credit is not claimed in this area at this time, pending implementation of the aquatic culture water recycle system.

Water Reuse and Recycling

Water from Lake Superior supplies the laboratory's cooling water needs. All non-contact cooling water used within the facility is recycled back to the lake. An additional opportunity exists to recycle aquatic culture water, pending implementation of a collection and treatment system for this purpose. BMP credit is not claimed in this area at this time.

7.0 DROUGHT CONTINGENCY PLAN

Water shortages are uncommon in Duluth due to an abundant water supply from Lake Superior. The City of Duluth does not have an official water management plan specifically for droughts, but it does have a general emergency action plan, which may be implemented if a drought occurs.
In the event that voluntary or mandatory water consumption reductions are instituted by Minnesota Department of Natural Resources or City of Duluth Public Works and Utilities Department, the Duluth Laboratory will form a task force of facility and operating personnel to identify and implement modifications to facility operations to achieve additional specified reductions in water consumption.

Minnesota drought information resources, including the Minnesota Department of Natural Resources Division of Waters Drought Response Plan is available at:

http://climate.umn.edu/doc/drought.htm

8.0 COMPREHENSIVE PLANNING

The Facilities Manager will ensure the water supply, wastewater generation, and water efficiency BMPs are taken into account during the initial stages of planning and design for any facility renovations or new construction. These factors will also be considered prior to the purchase and installation of any equipment that would measurably change facility water consumption.

9.0 OPPORTUNITIES FOR FURTHER WATER CONSERVATION

The Duluth laboratory is pursuing the following projects to achieve additional reductions in water use:

1) Recycle Aquatic Culture Water. The laboratory has submitted a FY 2005 building and facilities appropriation request to design and install a treatment and recycle system for aquatic culture water. This system would significantly reduce the quantity of water discharged to the city sewer. The laboratory has established a goal of reducing the fish culture water discharge by 80 percent by December 2006, pending approval of the necessary B&F funds. Achieving this goal would reduce the annual $110,000 sewer bill by $65,000.

2) Fish Culture Water Conservation. As part of the laboratory EMS, a target has been established to reduce culture water use by 5 percent.

3) Upgrade Toilets and Urinals. The laboratory will consider upgrading to the sanitary fixtures in the main laboratory building to current water efficient standards. Up to 13 toilets and 2 urinals could be upgraded. At an installed cost of $500 per fixture, simple payback on each fixture upgraded is 4 to 5 years, at current water and sewer rates. If urinals are upgraded, a waterless design will be considered. Waterless urinals can be installed for approximately the same cost as flush units, and eliminate the use of flush water.

APPENDIX A
WATER BALANCE SUPPORTING CALCULATIONS

MED Laboratory, Duluth, Minnesota

Process	FY 2003 Annual Consumption (gallons)	Supporting Calculations
Sanitary	750,000	Engineering estimate. Based on 20 gallons per person per day. Assume 150 people and 250 operating days. (150 people * 20 gallons/person-day * 250 days/year) = 750,000 gallons
Miscellaneous lab uses	223,000	Calculated as remaining difference from metered subtotal. 973,000 - 750,000 = 223,000 gallons
City water subtotal	973,000	Metered by city
Aquatic culture water (Wet Lab)	18,846,849	Metered total from meters #12 and #13. 7,989,479 + 10,857,370 = 18,846,849 gallons
Research water	5,930,000	Calculated as remaining difference from metered sewered subtotal: 25,780,000 -18,846,849 - 973,000 - 30,633 = 5,929,518 gallons
Reverse osmosis permeate	30,633	Metered total
Sewered water subtotal	25,780,000	Metered by city
Reverse osmosis reject	400,640	Calculated by difference of metered total RO use - RO permeate: 431,273 - 30,633 = 400,640 gallons
Non-contact cooling water (building and equipment cooling)	78,000,000	Calculated as remaining difference from metered subtotal: 119,786,700 gallons total - 17,000,000 tower overflow - 431,273 RO use - 5,930,000 research water - 18,846,849 culture water = 77,578,578 gallons
Water tower overflow (to prevent freezing in winter)	17,000,000	Engineering estimate based on winter of FY 2003. Assume baseline lake water use in non-cooling season is 5,000,000 gallons per month, based on December and April data. Assume spike load for January - March over baseline is water tower overflow. 31,844,000 gallons total Jan to March water use - 15,000,000 baseline use = 16,844,000 gallons overflow
Lake water subtotal	119,786,700	Metered
Total water use	120,759,700	Sum of metered subtotals